FRANK W. DAVIS
Institute for Computational Earth System Science
University of California
Santa Barbara, California

18

Comparison of Late Seral / Old Growth Maps from SNEP versus the Sierra Biodiversity Institute


Back to CD-ROM Table of Contents

Background

The Sierra Biodiversity Institute (SBI) produced a map of Late Seral/Old Growth Forest in the Sierra Nevada from 1990 Thematic Mapper (TM) satellite data. TM data with a spatial resolution of 0.125 ha were classified into 2 classes (LSOG vs. non-LSOG) based on spectral properties of a large set of training sites that were visited in the field. Effort focused on mapping late seral conditions in the westside, montane mixed conifer forest type. The final map, which covers both public and private lands, was produced at 1 ha (2.47 ac) resolution.

SNEP's LSOG database was prepared by resource specialists from the USDA Forest Service, the National Park Service, and other state and federal land owners. The database was prepared for public lands only and provides a landscape-level representation of forest composition and structure with an average polygon size of around 1000 ha (2500 ac). Each polygon is assigned a dominant vegetation type and an overall LSOG ranking of 0 to 5 based on the extent and structural features of forest patches within the polygon. Langley (1995) examined the accuracy of the ratings of forest patches within mixed conifer polygons and found considerable variation in forest structure at the local and patch level.

Because they were prepared at different spatial resolution using different data sources, classification rules, and mapping procedures, SBI and SNEP offer two alternative and somewhat complementary views of the distribution and extent of late seral forest in the Sierra Nevada. The former is spatially consistent and fine-grained but thematically coarse, whereas the latter is somewhat inconsistent in source information and mapping method, spatially coarse-grained, but contains richer thematic descriptions of forest structure, composition, and management history.

The purpose of this exercise is to compare SBI and SNEP maps of LSOG forest. *The objective is not to assess the statistical accuracy of either product, nor to endorse one or the other map.* Rather, it is simply to document differences in mapped LSOG area, illustrate spatial patterns of agreement or disagreement between the maps, and to provide possible explanations for those patterns.

Study Area and Methods

SBI and SNEP LSOG maps were compared over the national forests and national parks of the western slopes of the Sierra Nevada and the Lake Tahoe Basin. Inyo, Toiyabe, and Modoc National Forests were not included.

For the analysis, we generated 1 ha grids of SNEP forest type and LSOG rank, and overlaid those grids with the SGI map to create 3-way contingency tables of type, rank, and SBI class. Input data from SNEP included seventeen land cover types, but only six montane conifer forest types were considered in subsequent data analyses: Jeffrey Pine, Upper Montane Red Fir, Montane Mixed Conifer, White Fir, and Eastside Pine/Pine-Fir. The total area of LS/OG polygons assigned to these types is 2,459,121 ha (table 1). Upper Montane Red Fir and Montane Mixed Conifer types comprise 88% of this area (table 1).

The study area was divided into northern and southern sectors in order to test for any systematic effects related to latitudinal gradients in environmental factors, forest structure and composition, or land management. The northern sector included the Eldorado, Tahoe, Plumas, and Portions of the Lassen National Forests, as well as the Lake Tahoe Basin. The southern sector included the Stanislaus, Sierra, and Sequoia National Forests as well as Yosemite and Sequoia/Kings Canyon National Parks. The Jeffrey Pine type is distributed mainly in the southern sector, and White Fir and Eastside Pine types are predominantly in the northern sector. Red Fir and Mixed Conifer types are well represented in both sectors (table 1).

Results

Jeffrey Pine Forest

Of 130,000 ha in this type, 7.7% was ranked by SNEP as Rank 4 or 5, and 58% as Rank 3. Roughly 10% of SBI cells in this type were classified as LSOG. There is very low association of SNEP polygon rank and SBI LSOG status: for example, only 16% of the area in Rank 3 or Rank 4 polygons is also mapped as LSOG by SBI (Table 2). This is not surprising given the low density and crown cover of many late successional Jeffrey Pine stands on thin soils of ridges and outcrops. These stands could be given high ratings by SNEP but would be spectrally unlike the denser and more closed stands that were used by SBI to train their spectral classifier.

Upper Montane Red Fir Forest

This type is roughly equally distributed between northern and southern sectors and totals 624,700 ha. In the north, 15% of the area in this type was assigned by SNEP a rank of 4 or 5, compared to 35% in the south. SBI indicates a similar pattern, with 14% of the area of the type in the north classified as LSOG versus 23% in the south. The fraction of polygon classified as LSOG by SBI is positively correlated with SNEP's LSOG rank, but the association appears stronger in the north than the south (table 2). Over the entire region, the fraction of SBI pixels is around 10% for rank 1 and rank 2 polygons, and around 30% for higher ranking polygons. Given the closed nature of both mid and late seral stands of Red fir, one might predict that it would be difficult to spectrally discriminate among the higher ranks using TM data. There is no obvious explanation for the better association of SBI and SNEP ratings in the northern Sierra. Perhaps it is related to management history and the stronger contrast among stands of different rank on national forests compared to those on national park lands.

Montane Mixed Conifer Forest

This forest type was mapped over more than 1.5 million hectares. In the north, 13% of the area was assigned to rank 4 or rank 5, compared to 16% of the area in the south. Twenty percent of the total area was classified by SBI as LSOG. Overall, the fraction of area in SBI LSOG increases steadily as SNEP LSOG rank increases (table 2, figure 1). For example, less than 3% of the area in rank 1 polygons is classified as SBI LSOG compared to 61% in rank 5. This relationship is similar in both northern and southern sectors (table 2). The association of SBI LSOG and SNEP rank is much stronger for this widespread type than any other forest types, as one would predict given that SBI's mapping effort concentrated specifically on Sierran Mixed Conifer Forest.

Close to one million hectares or nearly two-thirds of the area of Montane Mixed Conifer type was rated by SNEP as rank 2 or 3. Thus based on absolute area, considerably more SBI LSOG occurs in lower ranking SNEP polygons than in higher ranking polygons. Specifically, SBI classified 168,236 ha within SNEP rank 2 and rank 3 polygons as LSOG, compared to 114,136 ha in rank 4 and rank 5 polygons. This discrepancy could be related to SBI's finer resolution mapping, which would be more likely to detect small patches of late seral forest in landscapes of predominantly early or mid-seral conditions. The spatial pattern of SNEP rank and SBI class suggests that this is often the case but that there are also large contiguous areas where the mapping systems disagree (figure 2).

White Fir Forest

Nearly all of the mapped extent of this type occurs in the northern sector (table 1). Seventy-percent of the area was rated by SNEP as rank 2 or 3, compared to 11% in rank 4 or 5. SBI also classified 11% of the area as LSOG, but there is little relationship between SBI class and SNEP rank for this type. As with the Upper Montane Red Fire Forest Type, the closed nature of regenerating stands of this type make it difficult to spectrally discriminate seral stages.

Eastside Pine/White Fir-Pine Forest

Of the nearly 122,000 ha mapped to this type, only 8% of the areas was rated by SNEP as rank 4 or rank 5, a number quite close to the 9% classified by SBI as LSOG. The relationship between SNEP rank and SBI class is not strong, with less than 3% of the area in polygons of rank 1 or 2 classified is LSOG, compared to 14% for rank 4 and 7% for rank 5.

General Observations

If one classifies SNEP polygons or rank 4 and 5 as areas of late seral/old growth conditions, then one obtains quite comparable estimates of LSOG area by forest type using SBI versus SNEP data. However, there is only modest association between the two representations in the actual *location* of LSOG conditions. Association is highest for the Montane Mixed Conifer Type, such that one could predict with fair success the rank of the SNEP polygon based on the proportion of the polygon mapped by SBI as LSOG forest. Association between SNEP and SBI representations of LSOG distribution is relatively low for the remaining types. Spatial patterns of disagreement indicate both local and landscape scale differences between the two representations. With the exception of Upper Montane Red Fir Forest, regional differences in the relationship between SNEP and SBI maps are not pronounced.

There are many possible explanations for the observed patterns of association between SBI and SNEP. The two overriding differences between the two appear to be the spatial resolution of the mapping and the SBI's use of TM imagery versus SNEP's use of air photos and expert opinion.

Tables

Table 1. Mapped extent of six major forest types on the western slpoes of the Sierra Nevada, as classified and mapped by SNEP's LSOG assessment team. The fractional distribution of the types among subregions and among SBI's mapped LSOG (SBI=1) and non-LSOG (SBI=0) is also tabulated. For example, of the total area mapped by SNEP as Montane mixed conifer, 56.51% falls in the northern sector of the study region. Over the entire region, 19.01% of the area mapped by SNEP as Montane mixed conifer was classified by SBI as LSOG (12.71% + 7.30%).

Table 2. Relationship between SNEP LSOG rank and SBI LSOG as a function of forest type and region. Region 1 is the northern sector and Region 2 the southern sector. Cell values are the percent of area classified by SBI as LSOG for each combination of region, forest type,and LSOG rank. For example, 33.2% of the area in the northern Sierra that was mapped by SNEP as Rank 3 Montane mixed conifer was classified by SBI as LSOG. The final column is the percent of total area of the type in each region that was classified by SBI as LSOG.

TABLE 1

	NORTH				SOUTH					
	Area	*SBI=0*	*SBI=1*	**Subtotal**	**Area**	*SBI=0*	*SBI=1*	**Subtotal**	**Total Area**	**Grand Total**
	(ha)				**(ha)**				**(ha)**	
Jeffrey Pine	6686	4.29%	0.87%	**5.15%**	123033	84.75%	10.10%	**94.85%**	**129719**	**100.00%**
Upper Montane Red Fir	299682	41.24%	6.73%	**47.97%**	325021	39.84%	12.18%	**52.03%**	**624703**	**100.00%**
Montane Mixed Conifer	867855	43.80%	12.71%	**56.51%**	667799	36.18%	7.30%	**43.49%**	**1535654**	**100.00%**
White Fir	42554	82.24%	8.00%	**90.24%**	4601	8.69%	1.07%	**9.76%**	**47155**	**100.00%**
Eastside White Fir/Fir-Pine	117979	90.20%	6.59%	**96.79%**	3911	3.09%	0.11%	**3.21%**	**121890**	**100.00%**
Total									**2459121**	

TABLE 2

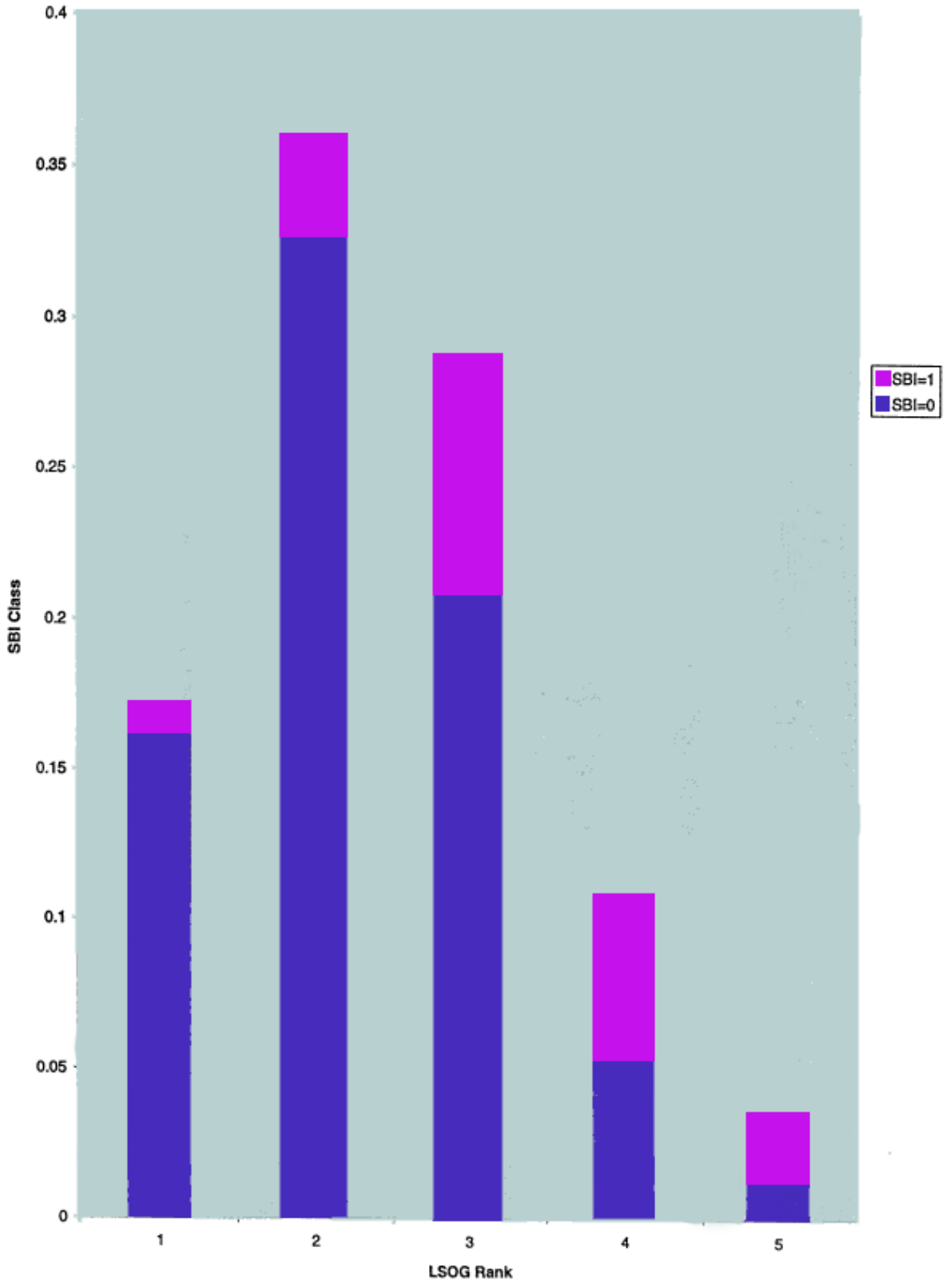
		SNEP LSOG RANK						
Type	Region	0	1	2	3	4	5	ALL
Jeffrey Pine	1	16.4%	25.0%		16.6%	19.9%	16.8%	17%
	2	0.0%	2.0%	10.8%	16.5%	16.7%		10.6%
	All	16.4%	2.0%	10.8%	16.5%	16.9%		11.0%
Upper Montane Red Fir	1		5.4%	8.6%	19.6%	20.1%	54.5%	14.0%
	2		11.0%	10.0%	28.4%	38.1%	25.4%	23.4%
	All		8.8%	9.1%	24.0%	31.4%	28.1%	18.9%
Montane Mixed Conifer	1	4.9%	8.7%	13.3%	33.2%	49.2%	62.1%	22.5%
	2	0.5%	1.0%	5.9%	20.7%	48.0%	61.2%	16.8%
	All	2.8%	5.0%	10.6%	27.3%	48.7%	61.4%	20.0%
White Fir	1	19.7%	3.5%	2.7%	16.6%	6.2%		8.9%
	2	6.1%			16.9%		19.8%	11.0%
	All	19.7%	4.5%	2.7%	16.6%	6.2%	19.8%	9.1%
Eastside Pine/Pine-Fir	1		2.8%	1.3%	10.5%	14.1%	13.8%	6.8%
	2		0.0%				6.8%	3.6%
	All		2.6%	1.3%	10.5%	14.1%	7.3%	6.7%

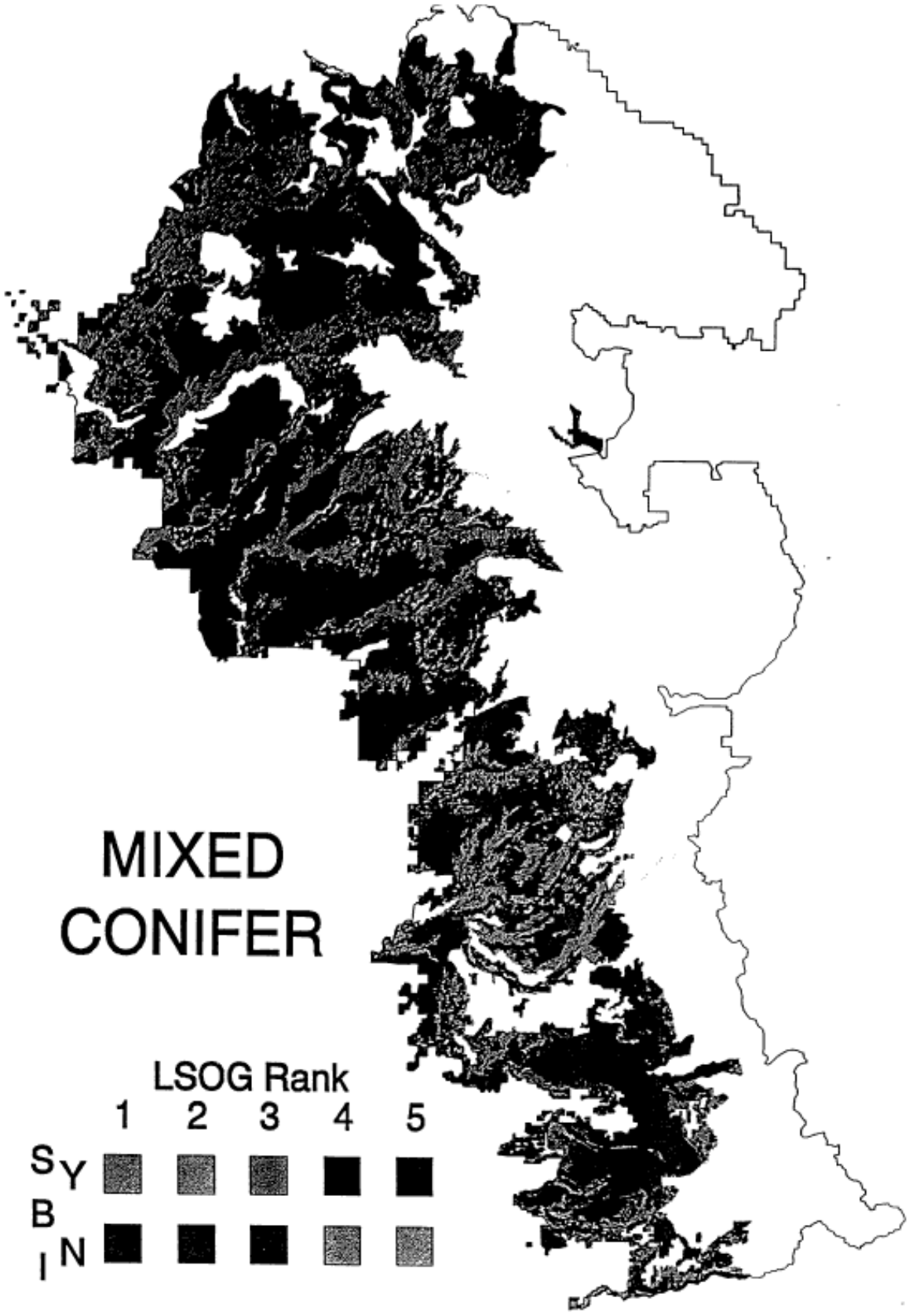
Figures

Figure 1. Barplot showing the relative amount of Montane mixed conifer forest type as a function of SNEP rank and SBI LSOG.The height of the each bar is proportional to the area in that LSOG rank. The dark shaded portion of the bar indicates the fraction of that SNEP rank that was classified by SBI as LSOG. Thus, most Montane mixed conifer was assigned a rank of 2 or 3. The proportion of area classified by SBI as LSOG increases steadily with rank. However, the absolute area in SBI LSOG in ranks 2 and 3 exceeds that in ranks 4 and 5.

Figure 2. Spatial patterns of co-occurence of SNEP forest ranking and SBI LSOG for Eldorado, Stanislaus, and Tahoe National Forests.

Figure 1


Sheet1 Chart 1
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
SBI Class
1
2
3
4
5
LSOG Rank
SBI=1
SBI=0




Back to CD-ROM Table of Contents